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THE CAUSES OF HEAT AND COLD IN THE Several CLIMATES and SITUATIONS of this GLOBE.

[Price One Shilling.]

THE CAUSES OF HEAT AND COLD IN THE Several CLIMATES and SITUATIONS of this GLOBE, ſo far as they depend upon the Rays of the SUN,

CONSIDERED

In Order to ſhew that the Difference of HEAT and COLD in other COUNTRIES may be nearly aſcertained by a Thermometer.

As it was Read to the ROYAL SOCIETY

By *T. SHELDRAKE*.
Author of the HERBAL.

Printed for and ſold by the Author at the *Black-boy* in the *Strand* near St. *Martins-Lane*; and by M. Cooper in *Pater-noſter-Row*.

M DCC LVI.

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TO

The Right Honorable

GEORGE

EARL OF *MACCLESFIELD*,

VISCOUNT *PARKER*,

PRESIDENT

OF THE

ROYAL SOCIETY.

MY LORD,

I SHOULD not have preſumed to have approached your Lordſhip with this ſmall Tract, if it had not been honored with a hearing before the Members of the ROYAL SOCIETY, and, as the late Doctor *Mortimer* aſſured me, approved by them.

Whatever may be the Merit of the Performance, I hope the Candor of the Public will excuſe its Defects, and your Lordſhip from your known Goodneſs and Humanity forgive the Preſumption of its Author, in addreſſing it to your Lordſhip,

being,

MY LORD,

YOUR LORDSHIPS

moſt obedient and

moſt humble Servant,

T. SHELDRAKE.

THE CAUSES OF HEAT AND COLD IN THE SEVERAL CLIMATES AND SITUATIONS OF THIS GLOBE.

THE Senſes of Men are wonderfully adapted to their ſeveral correſponding Objects in Nature: the Ear to Sounds, the Palate to Taſtes, Feeling to every Touch, Smelling to Odours, and the Eye to Colours. Almoſt infinite is the Variety of Objects that employ the Senſe of Viſion, and among theſe the Flowers that riſe ſpontaneouſly to adorn and beautify the Face of Nature, are not the leaſt engaging. They have Charms to allure and gratify the Organs of Viſion and of Smelling; they have Wiſdom and Contrivance in their Forms and Structure to engage the Study of the Philoſopher, and to excite Meditation in the Divine: and as their Beauty charms our Eye, their Virtues adminiſter to the Relief of every Animal in the Cure of various Maladies. It is not therefore Curioſity, or Ornament alone, that enduces us to wiſh we could teach the vegetable Productions of other Countries, to grow in Engliſh Ground, but Health and Piety join our Ideas of Beauty, and all perſuade the Culture of every fair and uſeful Flower, Herb, Vegetable and Tree, whether it be the Growth of this or the remoteſt Clime.

As we have no certain Rule for determining the Heat, that exotic Plants may require in Summer, nor unleſs by dear-bought Experience what Degree of Cold they could with Safety bear in Winter, I was led to conſider, whether it might not be poſſible to diſcover ſome Method for determining how much leſs the Cold of the Winter in more Southern Climates might be, than in ours, and in what Proportion their Heat alſo might probably exceed that of our Summers, by adjuſting a Thermometer ſo as to aſcertain the Difference; that if it were poſſible we might, by the Aſſiſtance of good Greenhouſes, Thermometers and Stoves, have the Pleaſure of ſeeing Exotics here in almoſt the ſame Beauty and Perfection as in their native Countries.

With this View I attentively and conſtantly regarded the Changes of Seaſons, and the Riſe and Fall of the Spirits in the Thermometer, knowing that the Difference of Seaſons, as well as the different Degrees of Heat or Cold of Seaſons in other Countries, depend upon the Changes of the Poſition of this Globe, with reſpect to the Sun, the only viſible Fountain of Warmth and Life. I alſo collected from Books ſuch Obſervations as might aſſiſt me in this Undertaking. And when I had proceeded thus far, I believed it was poſſible to determine very nearly the Degree of Heat and of Cold in moſt, if not all Countries with ſuch Exactneſs at leaſt, as that, with the Aſſiſtence of a Thermometer well graduated, foreign Plants might be preſerved in Health and Vigour.

The natural State of this Globe ſeems, from repeated Obſervations, to be what we call Temperate, or an intermediate Degree between Hot and Cold, as appears from the Warmth of deep Wells in Winter, and the Coldneſs of them in Summer, compared with the external Air, though, by a Thermometer, little, if any Variation is diſcoverable in the ſame Places, in oppoſite Seaſons. The ingenious Dr. HALES, in his *Vegetable Statics* pag. 62. from the honourable Mr. BOYLE, tells us, that the Spirits both Summer and Winter ſtood at Temperate in a Cave 130 Feet from the Mouth of it, and 80 Feet below the Surface of the Earth; which natural Warmth of the Earth is what ſecures Springs and all other Bodies from being frozen, few Winters proving ſo cold as to penetrate the Earth to more than twelve or fourteen Inches below the Surface.

The Tranſitions from the greateſt Heat to the greateſt Cold that we feel, in the Air embracing our Globe, is chiefly owing to the Elevation and Depreſſion of the Poles, which cauſes ſo great a Change in the Situation of the Earth, that the Obliquity and Perpendicularity, in which the Rays of the Sun fall, are continually in a State of Variation: and as the Face of the Earth forms Angles of Incidence by which they are reflected in direct or oblique Angles, back again under a vertical Sun in right Lines and diſperſedly, according to the Angle of the Plane on which they fall, ſo is Warmth increaſed or diminiſhed.

So far as Action and Reaction, occaſioned by Reflection, conduces to the Production of Heat, ſo far alſo will the Continuance of the Sun's Preſence, with the Slowneſs of his Motion be found to increaſe that Heat: and on the contrary, Cold will be increaſed by the Obliquity of his Rays, the Swiftneſs of his Motion, and the Time of his Abſence below the Horizon, which is much longer than is his Preſence above.

Upon theſe Principles it will appear, that a regular Increaſe of Heat ſhould always follow the Approach of the Sun, and as gradual a Decreaſe of Warmth, or Increaſe of Cold, always attend his Departure; but this is not ſo either on the Continent or the Iſlands.

There are many Accidents that occaſion very great Variations from ſuch regular Changes, from Heat to Cold and from Cold to Heat. Such as the Situation of Hills, Mountains, and the Declivity of Land from a true Plane: if the Deſcent be towards the South it will be warmer than it would be if towards the North.

Clouds will ſometimes propagate Heat by Reflection, and Water-clouds will make the Air cool.

Winds from the South, if without Rain, and from the South-weſt, always increaſe Warmth; as on the contrary, Winds from the Eaſt, North-eaſt, North and North-weſt, always bring a colder Air with them, than was felt before they began to blow. By all theſe Changes Fermentation and Vegetation is greatly promoted.

Whenever Water becomes a reflecting Plain, the Smoothneſs of its Surface increaſes very much the Heat of the Sun's Rays, but much more ſo when united, they then produce almoſt double the Heat the Sun would do without ſuch Reflection.

Certain it is, that all Bodies, whoſe Surfaces being poliſhed reflect Light, reflect Heat alſo along with it; the Degree of which will bear a juſt Proportion to the Cloſeneſs of the Pores, the Size of the Diameter and Degree of Convexity or Concavity of the Surface. How bright is the Central-point of Light, and how ſtrong muſt the Heat of ſuch a concave Burning-glaſs, as Mr. Vilette's be which ſoon diſſolves Metals *&c.*? On the contrary, the Moon, which is a ſpherical Body, reflects a faint

Light, compared with that of the Sun; but no Heat is to be raiſed from any Collection of its Rays. For the ſame Reaſon that the Moon reflects no Heat, the Tops of Mountains in hot Countries are ſeldom free from Snow, becauſe the Whiteneſs of the Snow reflects the Heat back again in ſuch a Divergency as to prevent any Heat from being generated. And therefore the Plants that grow upon Mountains in hot Countries, will alſo grow upon Plains in colder Countries; this is evident from the Cedars which flouriſh in the Botanic Garden at Chelſea. But as the greateſt Dimenſion of Mountains is towards their Baſe they gradually acquire Warmth, till it becomes nearly uniform with the Plain on which they ſtand.

Heat is always increaſed or diminiſhed, as the Colour of the Body, on which the Rays of the Sun fall, is light or dark, or admits of different Shades from white to black; and as the Surface of the Body is ragged or ſmooth. Black abſorbs Light, and if the Surface be rough, it will grow warm much ſooner than if it were ſmooth: White, on the contrary, reflects Light and Heat, and that more vigorouſly from a poliſhed Surface. This is the Reaſon why white Bodies are ſlower in taking Fire than thoſe that are black. The ſame holds true of all intermediate Degrees of Colour, in Proportion as they recede from the grand Oppoſites, black and white. If we walk on a black Sand, or dark dry Soil, our Feet will grow very warm from the Heat that the Sand or Soil has imbibed from the Sun, but our Faces will feel little, if any Warmth reflected from the ſame Soil: whereas if we walk on dry Chalk, white Sand, *&c.* our Feet will not acquire any conſiderable Degree of Heat from them, but our Faces will feel, by a ſtrong Reflection of Light and Heat from ſuch white

Ground or Sand, a very ſenſible Alteration, which will be aggravated, if the Sun ſhine upon us at the ſame Time.

All Increaſe of Heat above Temperate is owing to the Rays of the Sun becoming daily more and more perpendicular, for the Reflection becomes ſtronger as the Rays deſcend in more direct Lines, are preſt cloſer, and continue longer above the Horizon. Cold, on the contrary, increaſes in Proportion as the Sun's Rays become more oblique, for by this Obliquity they are thinner, more diſperſed and fainter, which muſt daily diminiſh and abate the Force of Reflection. Not that we have our greateſt Heat when the Sun is in Cancer, and neareſt vertical on the 21 of June, nor our greateſt Cold when the Rays of the Sun, at his Entrance into Capricorn, are moſt oblique, and thin, being extended to their greateſt Length, when Days are ſhorteſt and the Sun's Stay longeſt below our Horizon. But our greateſt Summer's Heat is commonly in July, and our greateſt Cold in January: from which Obſervation it appears that Heat increaſes by the Continuance of Action, notwithſtanding what cauſed it grows weaker; and Cold increaſes, notwithſtanding the Sun's Approach, till his thinly diſperſed Rays become cloſer collected together, and his Preſence is longer with us. Thus we often experience in clear Days, that our greateſt Heat is not till the Sun is gone ſeveral Degrees weſtward, nor the greateſt Cold of the Night till the Sun has left the Nadir, and is gone many Degrees towards the Eaſt. Common Experience proves that, when a Body is hot, a leſs Degree of Heat will preſerve that Heat, than was required to generate it; and ſo on the contrary with reſpect to Bodies that are cold, more Heat is required to put the Parts in Motion again, than will keep them ſo when once agitated.

From what has been ſaid it is evident, that Heat and Cold are cauſed by the Rays of the Sun being more or leſs vertical, from whence proceed not only the different Degrees of Heat and Cold in different Climates, but alſo the Variety of Seaſons in one and the ſame Climate, ſo neceſſary for the Production and Growth of all the various Tribes and Species of Animals, Inſects, Vegetables, which require different Degrees of Heat and Moiſture.

I tryed with a Thermometer Tube, which was not fixed to a Board, how much the Heat of the Sun would raiſe the Spirits in the Tube higher than they were at in a Room of a South Aſpect, in which I keep my Standard Thermometer, the Windows being open, and I found the Sun's Rays aſſiſted by the Reflection of them from a red Brick-wall at about three Foot Diſtance raiſe the Spirits, in the hotteſt Part of an Afternoon in July, 20 Degrees above the Height they were at in the Chamber at about ten Feet from the Window.

By this Experiment we ſee how the Rays of the Sun on one Side and the Reflection of them on the other Side of a Thermometer Tube raiſed the Spirits to a Heat ſomuch ſuperior to what they were in the Chamber, as above mentioned.

As the Earth, like all the other Planets, moves in an elliptic Orb round the Sun, we on the North-ſide of the Equator enjoy thereby eight Days more of Summer, reckoning from the vernal to the autumnal Equinox, than the Inhabitants on the Southern Side of the Equator, whoſe Winter is eight Days longer than ours. This together with their greater Diſtance from the Sun, makes it reaſonable to ſuppoſe that their Cold alſo continues longer, and is more intenſe. Which Providence has provided as a Counter-ballance for the Good of his Creatures,

tures, that by the Earth's nearer Approach to the Sun in their ſhorter Summer than ours, it might receive a Degree of Warmth, as much ſuperior to what we have, as the Cold of the Southern Winter may exceed that of the Northern.

I am induced to think, as the Rays of the Sun, darting through the Atmoſphere in our Winter's Solſtice, are, by their Obliquity, nearly fourtimes the Length they are in Summer, which is evident from the different Length of Shadows at thoſe oppoſite Seaſons, that this greatly helps to vary the real Action and to abate the full Force of the Sun's Rays, which, if it did not, any thing in a true Plane to the Sun in Winter would be heated nearly, if not equal to, a Plane under the Sun in Summer. This plain Appearance of the Sun through the Atmoſphere is probably the true Reaſon why the Sun appears of a larger Diameter in December than in June. If it has not already been tryed, it would be well done to make a Trial with proper Inſtruments in the Month of June in a Morning, or in an Evening, when the Sun is of a Height above the Horizon equal to what it is in December. If this Experiment for meaſuring the Sun were made, and the Sun ſhould appear of the ſame Magnitude as in Winter, it would then be certain that the apparent Magnitude is owing to the great Tract of Atmoſphere through which we ſee it: which alſo makes the other Planets, particularly Venus and Jupiter, appear ſo much bigger ſoon after their Riſing, or before their Setting, than they do when in their Meridian Altitude; at which Time they are nearer to us by almoſt one Semidiameter of the Earth, than they are at their Riſing or Setting.

From what has already been ſaid, I hope, it will be allowed, that all the Variety of Heat and Cold that we feel in the Air, as well as the Changes that are produced on the Surface of the Earth and Waters, *&c.* are owing to the diverging or converging of the Sun's Rays, their Obliquity or Perpendicularity. By the latter Motion is increaſed, and thereby Warmth or Heat in equal Proportion; and by the former Motion is abated, and therefore Cold will increaſe continually as Action decreaſes and Bodies come nearer to a State of Reſt. Here we muſt not forget that the Changes of the Wind will alſo influence and prevent the regular Alterations of the Air, *&c.* I have ſeen the Spirits in the Thermometer at the 4th Degree when the Sky has been clear, very little Motion in the Air, the Heat almoſt inſupportable, and the Fleſh in the Market began to be offenſive before 3 in the Afternoon; and the next Week the Spirits roſe one Degree higher, the Sun not obſcurd but a briſk Wind then blowing, no ſuch Effects were produced. Hence the Neceſſity of Air as well as Warmth for the Preſervation of animal and vegetable Subſtances.

It is certain that all Parts of this Globe enjoy the ſame Quantity, or nearly ſo, of the Sun's Preſence in the Space of a Year, and it is certain that all Places do not enjoy the ſame Quantity of Heat from his Preſence.

As the Sun's Motion from North to South, and from South to North is confined between the Tropics, ſo is his Motion ſwifter there, then in any other Part of the Globe: and the nearer vertical to the Equator, ſo much the ſwifter is his Motion from Eaſt to Weſt, and from North to South, and South to North. This will appear from the following Obſervation.

Firſt, The Sun paſſes from 3 Degrees 30 Minutes South Latitude, to 3°. 30′. North Latitude, being together ſeven Degrees, in about eighteen Days, whereas, when the Sun enters

Gemini on the 21 Day of May, at twenty Degrees North Latitude, the Sun ſpends one intire Month in going three Degrees and thirty Minutes, or till he enters cancer and touches the Northern Tropic, and another Month in returning back from the Tropic till he arrives at Leo, on the 23 of July: in all which Time, being Sixty Seven Days, the Sun is as near the Tropic, as he is to the Equator for eighteen Days. Hence it appears reaſonable to ſuppoſe, notwithſtanding the Sun paſſes the Equator twice in the Space of Twelve Months, as ſpending only Thirty-ſix Days in theſe two Tranſits, that the Heat under either of the Tropics may be as great, if not greater than under the Line.

Secondly, For a further Proof of the Probability that the Heat under the Tropic is as great, if not greater, than under the Line, I ſhall juſt obſerve the Difference of the Time of the Sun's

Motion in the abovementioned different Places on the Surface of the Globe, *viz.* As the Sun moves Fifteen Degrees of 60 Miles each (comcom Computation) in one Hour under the Equator which are Nine Hundred Miles, and as the ſame longitudinal Degree under the Tropic contains only Fifty-five ſuch geographical Miles, which amount to no more than Eight Hundred and Twenty-five Miles, *i. e.* the Sun travels Seventy-five Miles leſs in one Hour under one of the Tropics than under the Equator. The Motion of the Sun then being ſlower, may we not with Reaſon ſuppoſe that the Heat may thereby be raiſed to a more intenſe Degree by the Sun's being nearly ſo long vertical, and withal his Motion ſo much ſlower under the Tropic then it is under the equanoctial Line? It is alſo to be remembred in this Place, that the Sun in our Summer half Year remains about 140 Hours longer above the Horizon under the Tropic than under the Equator; which muſt certainly conduce to the increaſing of the tropical Heat to a greater Degree than of that under the Equator.

Having proceeded thus far, I ſhall now deſcribe the Method I uſed for making the Scale.

Having attentively and duly conſidered the foregoing Cauſes of Heat and Cold, I took a Thermometer, and keeping it in one conſtant Place, I carefully obſerved, and marked the greateſt Variation of the Spirits, by which I obtained their Height in the Heat of a kind, good Summer, and their Deſent in a hard Froſt. I then deſcribed a large Circle of ſeveral Foot diameter, and, according to the common Rules of Geometry, divided it into Degrees, &c. and according to the known Rules of Geography laid down the Tropics, Circles, Paralels, &c. Having done this I drew a Line in a true Plan from North to South, ſuppoſing the Sun vertical in cancer, by which it appeared, that the Rays of the Sun at Forty-ſeven Degrees Northern Latitude, were as cloſely connected as under the Equator; that the Sun was at an equal Diſtance from the Equator, as he was from Forty-ſeven Degrees North Latitude; that the Northern Part of Italy might with great Probability, in its neareſt approach to the Sun and greateſt Heat, have a Degree of Heat equal, or nearly the ſame, with that under the Equator in the greateſt Cold and greateſt Receſs from the Sun: and that Fifty-two Degrees and Forty-two Minutes Northern Latitude were further from the Sun, when vertical in cancer, than the Tropic by ſeven Degrees and Forty Minutes, or nearly ſo. In this Poſition of the Globe, I formed the firſt Table under the Name or Title of, Difference of the Sun's Diſtance, in which Tables the Difference of the Sun's Diſtance at every five

Degrees of Northern Latitude, is laid down by Menſuration *.

This being finiſhed, I proceeded in like manner for making the ſecond Table under the ſame Title as the firſt, the Sun being vertical under the Equator, as in Libra and Aries; and the third alſo under the ſame Name, the Sun being in Capricorn; which ſhews how much theſe Northern Countries are removed further from a true Plan, under a vertical Sun, in December, than they are in June. In theſe two laſt Tables, the Difference is laid down at every five Degrees, and may be of the ſame Uſe on the South as on the North Side of the Equator.

Theſe Tables being thus adjuſted, I fixed the Point of greateſt Height, to which the Spirits riſe with us, in the greateſt Heat of our

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* Theſe ſo nearly anſwer Computation, that where there is any Difference 'tis inconſiderable.

Summer, at that Point of our Diſtance in Degrees and Minutes as according to the firſt Table we at 52 Degrees and 42 Minutes here are, from a Plan under the Sun, when vertical in cancer, than the Tropic itſelf, or 23 Degrees 30 Minutes is. And when the Spirits were by a very hard Froſt ſunk down, I marked the loweſt Point they fell to at the Number of Degrees and Minutes of our Receſs from the Sun when vertical in Capricorn, according to the third Table of the Sun's Diſtance, which gives the Difference of about Thirty-eight Degrees. This very conſiderable Increaſe of Cold (from our greateſt Heat) in Summer we can and do feel by the Rays of the Sun being ſo very Oblique in Winter, as to bear little more than the Proportion of ſeven to one, ſo that the ſame Quantity of the Rays of the Sun that on the 21 of June falls upon a level Piece of Ground, ſuppoſe of one hundred Yards ſquare, will on the 21 of December be ſo diſperſed by this very great Obliquity and thinneſs as to deſcribe a true plain piece of Ground in the ſame Latitude of one hundred Yards in Breadth and full if not more than ſeven hundred in Length when the Sun is at its Meridian Altitude.

Having divided the Space in which the Spirits move into the above-mentioned Thirty-eight Degrees; and finding, by the Firſt Table, that the Inhabitants under the Tropic of Cancer are nearer the Sun upon the 21 of June, than we at 52°. and 42′. North Latitude are by ſeven Degrees and Forty Minutes, I then fixed the Point of greateſt Heat, as many Degrees and Minutes above our greateſt Heat as the Tropic is nearer the Sun than we are. This increaſe of Heat is very great and as hereafter will be ſhewn, is very juſt and afford the moſt exact Point.

Upon theſe Principles and Obſervations, all the different Degrees of Heat and Cold, in all Countries and Latitudes are determined, whether Northern or Southern, and are by the Tables for the Thermometer ſhewn. For I believe a City which lays nearer the Sun by two Degrees perpendicular Meaſure has the Rays of the Sun ſo much denſer or cloſer contracted, as to raiſe the Spirits two Degrees higher in their greateſt Heat than at London: ſo on the contrary, a City whoſe approach towards the Sun is not by ten Degrees perpendicular Meaſure, ſo near as London, cannot by the Angle of Incidence diſperſing the Suns Rays more than at London, have the Spirits in the Thermometer ſo high by Ten Degrees as marked in the above-mentioned Tables.

Having thus briefly ſet forth the Reaſons on which I founded the Scale for ſhewing by a Thermometer the Heat and Cold of any Country in any Part of the Globe, how much ſoever it exceeds or falls ſhort of what we do or may feel here in England, I ſhall endeavour to prove the certainty of this Scheme from the beſt Authorities.

Firſt as to the Coldneſs of the polar Parts of the Globe which is very great, though not every Winter alike, no more than with us.

The honourable Mr. Boyle in his Hiſtory of Cold has ſeveral quotations from the Dutch Voyage to Nova Zembla, *viz.* page 16—161. "That the Ground was frozen in the beginning of June", in the ſame page, he ſays, "On the Twenty-third of June Sun-ſhiny "Weather, yet the Heat not ſtrong enough "to melt Snow",---again in the ſame page, "that in July and Auguſt, their Heat is not "ſufficient to melt Ice in leſs than Eight or "Ten Days", and page 187, Mr. Boyle further ſays, "That in 74 and 75 Degrees

“ North Latitude July the Fourteenth Wind
“ Northerly both Snow and Froſt, and on the
“ Twenty-fourth Day of the ſame July, the
“ Wind. N. E. the Froſt was ſo hard, as to
“ freeze their Cloaths.

Theſe Winds undoubtedly made the Cold greater than it would have been with a South or South-weſt Wind.

The Cold of the Northern Circle in Winter is deſcribed as follows by the Members of the Academy of Sciences at Paris in the Year 1737. *viz.*

“ December the 21, that whenever they
“ would Taſte a little Brandy, the only thing
“ that could be kept Liquid, their Tongues
“ and Lips froze to the Glaſs, and the Cup
“ came away Bloody. See Page 78, 79, and
“ Page 82. Snow that was melted with Fire
“ was froze immediately, forming a Hearth of
“ Ice all round the Fire. That on the Thir-

" tieth of December the Mercury in the Ther-
" mometer fell down to Thirty-ſeven Degrees
" below the freezing Point, which was
" Twenty-three Degrees lower than they fell
" at Paris in the great Froſt, 1709. The
" Spirits of Wine were frozen in the other
" Thermometers".

This Cold is nearly equal to the Cold in my Tables, according to the Diſtance of the Sun and great Obliquity of his Rays. The Cold, when the Spirits are ſo low as Fifty Degrees from the greateſt Heat, is ſo intenſely ſevere as to congeal Drops of Water in Half a Minute into hard Ice: and I have ſeen a Glaſs of Brandy drank, the Spirit by the ſeverity of the Cold fly from what remained, when the Water on the Sides of the Glaſs has immediately freezed into a feathered Ice.

The very learned Dr. BOOERHAAVE ſays that the Cold of Ice-land was at 1 Degree above O, that is the Firſt Degree, meaſuring from the greateſt Cold upward. Which as near as I can find by comparing one Scale with another, and one Obſervation with another, is nearly as Cold as what the Members of the Academy of Sciences above-mentioned deſcribe the Cold of the Northern Circle to be. Their Winter might be Colder than that in which Profeſſor BOORHAAVE ſent his Thermometer to Ice-land. The Doctor ſays he obſerved in Leyden Garden in 1709, the Spirits to be Four Degrees above the Cold of Ice-land, that is at Fifty Degrees without Doors, or Forty-five Degrees within Doors; which is the greateſt Cold of Amſterdam as is laid down in my Tables of Heat and Cold. Thus nearly in Cold, does my Calculations and Scale of Cold anſwer to the above Obſervations.

Having by the foregoing Obſervations ſhewn how near my Scale for Cold comes to the

Truth of the Cold near the Poles, I ſhall now ſhew their nearneſs to Truth with reſpect to the Heat and Cold of ſome Countries, whoſe ſituation is nearer to the Equator.

The Ingenious Mr. Ray in a Collection of Travels which he Publiſhed ſays in Page 182. "The Winter is not very ſevere (at Bagdat) "in theſe Countries, which you may conclude; "for, that our March Flowers, as Hyacinths, "Narciſſus, Violets, *&c.* were in full Flower "in December, and that the Farmers went "to Plough at that Time", wherefore I judge their Winter is like our Spring. It is to be obſerved that their Winter was not come to its greateſt Cold, January being generally the coldeſt Month. Theſe were the Obſervations of Dr. Rowalf, a Native of Augſburg in Germany between the Forty-eight and Forty-nine Degrees of North Latitude.

Monſr. Rollins in his Ancient Hiſtory of the Egyptians, Page 21 ſpeaking of the Weather ſays, " The Egyptians begin to turn them " out to Graſs in November, and they Graze " till the end of March. Words could never " expreſs how rich their Paſtures are; and how " fat the Flocks and Herds (which, by reaſon " of the Mildneſs of the Air, are out Night " and Day) grow in a little Time.

As to the December Flowers at Bagdat blowing at the latter end of March or beginning of April, with us, allowing their Weather to vary in Proportion to ours here in England, which is not always, nor may I ſay at any Time the ſame, in different Countries of the ſame Latitude, but to allow it ſo, and upon obſerving our Weather in March the mean Motion of the Spirits is between Thirty or Cool, and Thirty-five or Cold. On the Thermometer Table in which Table the greateſt Cold of Bagdat is at

Twenty-ſix Degrees and Forty Minutes, the greateſt Cold of Augſburg being at Forty-one Degrees, the Cold of March there, according to my Tables will be at about Twenty-ſeven Degrees and Thirty Minutes, ſomething below Temperate, which is within leſs than one Degree of the greateſt Cold at Bagdat in the ſame Scale: upon comparing them together, it plainly appears that what Flowers blow with us in the beginning of April, may Bloſſom in the middle of March at Paris, Vienna, Augſburg, &c. being at an equal Diſtance from the Sun, and at Bagdat or any other Place under the ſame Latitude in December.

As to Egypt the greateſt Cold at Grand Cairo in theſe Tables is very near what we call Temperate: take the mean Height of the Spirits with us in November, it is generally about Cold, in all probability, the ſame Spirits in November, at Grand Cairo, would be found at a Medium, at Sixteen, or Seventeen Degrees, or nearly as High as very Warm according to the Scale in the Tables, and at the latter end of March to be at about eleven Degrees or nearly what we call Hot, or ſuch Weather as, (if the Summer proves kind,) we have in July, in a ſeaſonable kind Year.

Theſe Quotations from Mr. RAY, and Mr. ROLLIN, as alſo thoſe of the Northern Countries are what offered ſince I formed my Tables of Heat and Cold, which upon ſtrict Examination, finding them anſwer ſo nearly to what I had there laid down for the Heat and Cold of thoſe Countries, was I confeſs no ſmall Satisfaction to me to find my Tables for the Thermometer ſo very near Truth.

The greateſt Heat in my Scale for the Thermometer is upon Trial found equal to that of a healthy Man in Summer, which is the uſual Height of the beſt Thermometers, neither of which I had recourſe to for fixing the Point of Heat in my Tables, nor to the aforementioned Obſervations on the Cold of the inhabited Parts of this Globe: but the exceſs of Heat, more than what we Feel, neceſſarily ariſes from the nearer Situation to the Sun by contracting the Rays, *&c.* and the exactneſs in the Point of Cold being greater than with us is the natural Conſequence of a further receſs from and greater diſperſion of the Suns Rays.

I can from Experiments made on ſeveral Exotics, ſince I formed the abovementioned Tables, aſſert that any foreign Plants will perfectly well indure the changes of our Air, till the Spirits fall to the Cold, aſſigned to the Country from which they are brought, in the Scale for the Thermometer: by theſe Tables the growth of Exotic Plants is brought to a greater certainty than ever, and that curious Inſtrument the Thermometer is found much more entertaining and uſefull than it has heretofore been.

I ſhall now inform the Reader what the Particulars contained in the ſo often mentioned Tables are.

Firſt, a Table of Countries with their Latitudes in Degrees and Minutes, from the lateſt Obſervations, whether North or South, or both, and what Quarter of the World each Country lays in.

Secondly, three Tables in which the firſt Column ſhews the Degree of Latitude; the ſecond the Height of the Spirits in the Thermometer: the Numbers expreſſing which, being as the verſed Lines of the Diſtances from the Vertical Sun, may be found from theſe Tables to all Times and Places.

Thirdly, a Table of the Suns Motion in the Ecliptic, by which is ſhewn, not only how

Swift his Tranſit is croſs the Equator, but alſo how ſlow his Motion when he either approaches to, or departs from either Tropic.

Fourthly, a Table of Climates for finding the Length of the Day or Night in any Country or Latitude.

Fifthly, a Scale for a Thermometer by which is ſhewn how much the Heat of Summer, or the Cold of Winter, exceeds or falls ſhort of what is, or may be the Heat or Cold of England, alſo how much the Spirits are Higher abroad,. if riſing, or lower in the Air if falling, than in the Houſe. Likewiſe what Cities or Countries lay Parallel to each other, and what is the difference of Diſtance in perpendicular Meaſure in Degrees and Minutes, (when the Sun is Vertical in either Tropics) of each Country and moſt Cities.

Sixthly, a large Catalogue of Exotic Plants with the Countries where naturally Produced, curiouſly Engraved on a very large Copper-Plate, and Printed on Imperial Paper, inſcribed to Sir Hans SLOAN, Bart. and approved of and recommended by Mr. PHIL. MILLER, F. R. S, and Gardiner at the Botanic Garden at Chelſea.

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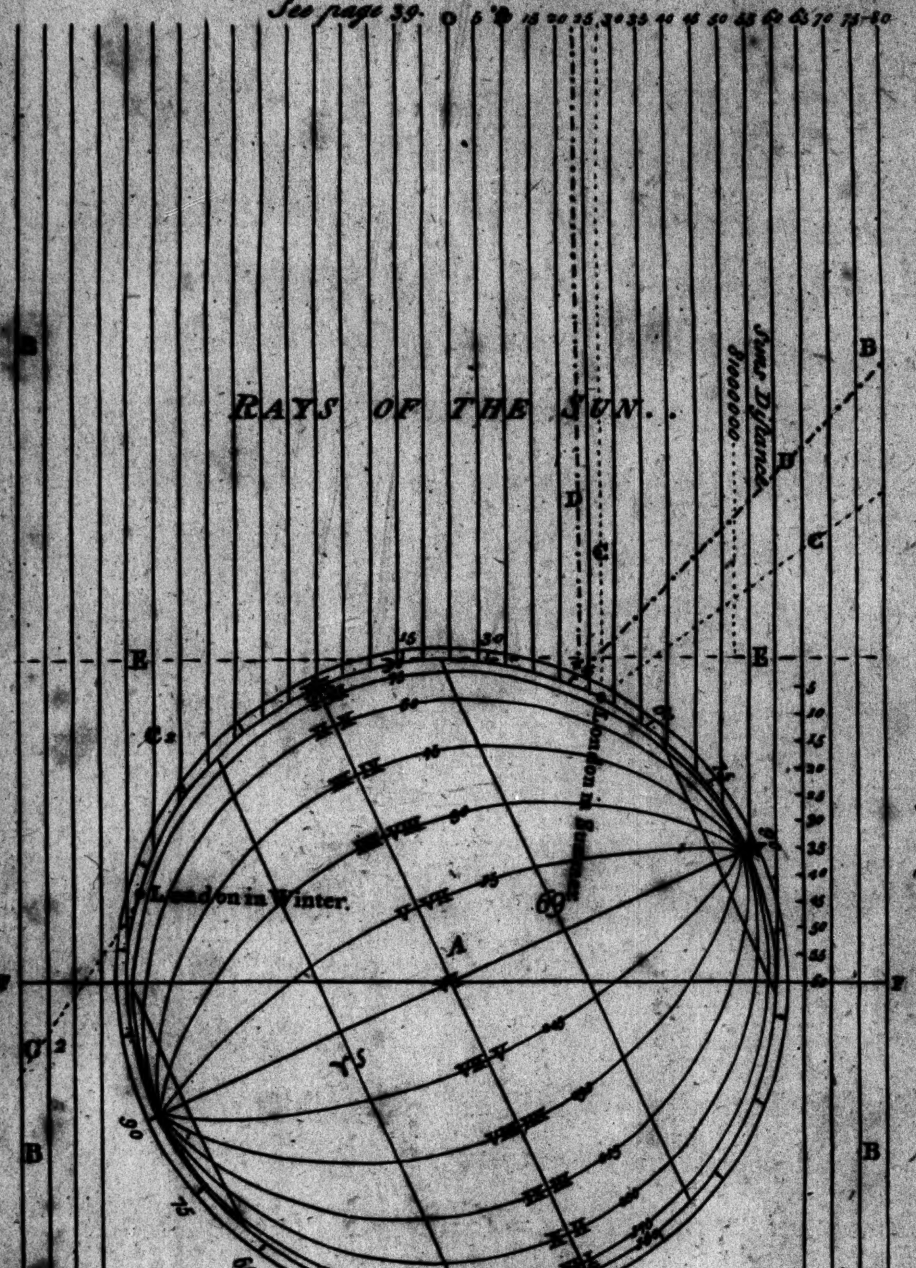
See page 39.



Designd and Drawn by T.S.

Explanation of the FIGURE.

A, Repreſents the Globe of the Earth, in its Poſition on the 21 of June, when the Sun is Vertical in Cancer; it is divided by the Equinoctial Line on which the Hours are marked, and by the Tropics and polar Circle. Again, it is divided from Pole to Pole at every Fifteen Degrees or every Hours Tranſit of the Sun. This will give a tolerable Idea of the Riſing and Setting of the Sun in the different Latitudes and Seaſons of the Year. The Line FF. deſcribes how much the Velocity of the Sun in his diurnal Motion is greater in one Latitude than another.

There is alſo a Circle that incloſes the Globe, divided at every Fifteen Degrees, repreſenting the Atmoſphere.

B. B. B. B. Theſe Lines repreſent the Rays of the Sun falling Perpendicularly upon the Earth; from a due Obſervation of which it will appear that the Surface of the Globe at a very few Degrees diſtance from the middle Rays which fall on the Tropic, reflects the Rays not Perpendicularly but Obliquely, and thereby abate the force of Re-action till that Power, which ſo much increaſes Heat, continually leſſens till entirely loſt; and the Rays of Light paſs by the Globe, without affording any Warmth.

C. C. The Point of this Angle ſhews nearly the Place upon the Globe on which London is ſituated, with the Angle of Reflexion, and alſo how much farther five Degrees of Rays diverge here than under Capricorn. In this Poſition of the Globe by this Angle of Reflexion, it appears, that as the Rays are reflected back in Lines more and more Oblique, Motion or Action, being thereby leſſened, Heat muſt for the ſame

Reaſon be alſo leſſened. D. D. Shews that 47°. Latitude is as near the Sun as the Equator, the Angle of Incidence being equal in both, the Velocity of the Sun leſs, and thereby the Heat at 47°. Latitude may be equal to the Cold under the Equinoctial Line.

C 2. C 2. Shews the extream Obliquity of the Suns reflected Rays at London, and how vaſtly wide the Angle of Incidence diſperſes the Rays of the Sun in Winter, or when the Sun is in Capricorn. The taking this point for the ſituation of London in Winter on the South-ſide the Globe could not eaſily be avoided without drawing another Diagram, to avoid which as well as the placing London in Winter ſo far North, as not to be Inhabitable, I thought it would be pardonable if I reverſed its Situation.

E. E. A pricked Line drawn parallel under a Vertical Sun in Cancer and touching the Globe in that Point to ſhew how the Diſtance from the Sun is increaſed in different Latitudes in Summer and Winter.

F. F. Another Line drawn croſs the Globe, and extended to ſhew by the horary Circles which interſect the Equator from Pole to Pole, the different length of Days and Nights, by exhibiting the Time the Sun Riſes and Sets in any Latitude, as alſo the different Spaces the Sun paſſes over in the ſame Period of Time.

FINIS.

ERRATA.

Page 18 line 11 *read* than.
20 l. 3 *r.* common Computation.
l. 17 *r.* than equinoctial.
21 laſt l. p. 23 l. 10 p. 24. l. 4 *r.* Plane.
22 l. 12 *r.* Fifty.
25 laſt l. *r.* affords.
19 29 p. 30 l. 9 *r.* BOERHAAVE.